PhoenixSim Parameters

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PhoenixSim is a photonic network simulator that is used for modeling and understanding photonic interconnection networks. PhoenixSim is implemented using OMNeT++, an open-source C++-based event-driven simulation environment.

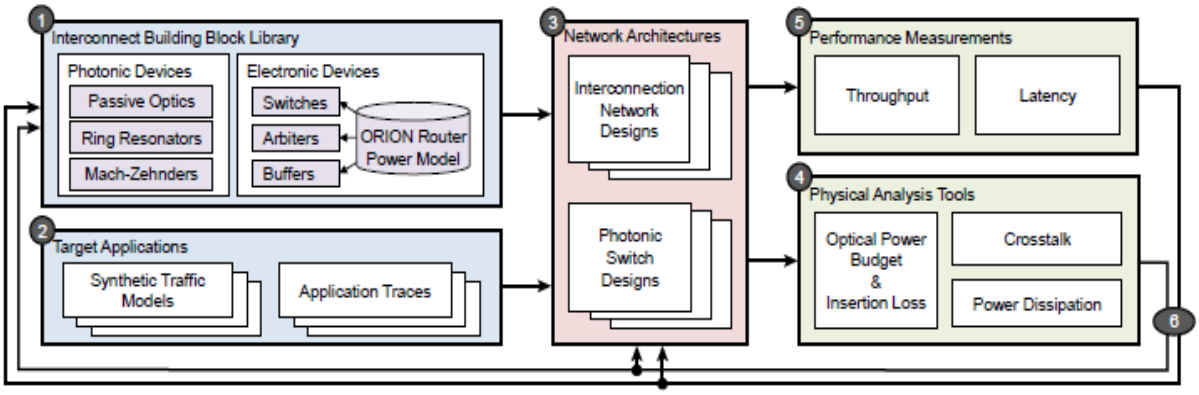

Figure 1: PhoenixSim Design Stages

The sequence of design stages we employ for modeling photonic interconnection networks primarily consists of six design steps: 1) specification of the network building blocks, 2) specification of the target application, 3) modeling of the network architecture, 4) system-level performance analysis, 5) physical-layer characterization, and 6) iterative refinement of parameters and design.

We use a level of abstraction by establishing a set of characteristic device parameters that are key to measuring the physical and system metrics which are important to our understanding of photonic interconnection networks.

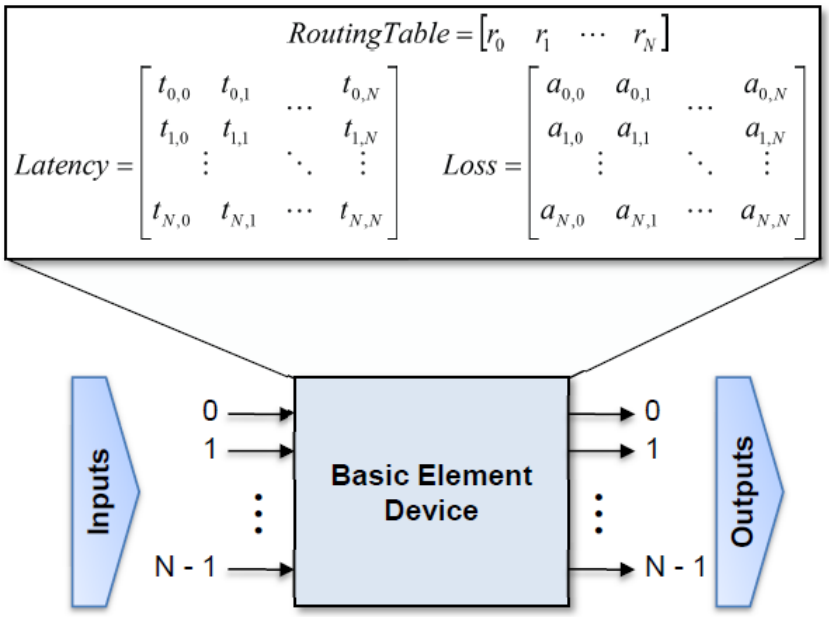

Figure 2: Parameters for characterizing a photonic model using the Basic Element Device in PhoenixSim

We use a logical routing table to determine the path a message takes through the device. Fig. 2 shows how the routing table can be represented as a length-N vector, where the index represents the ingression port of an optical signal and the value at the index represents the egression port. There are also two tables to represent the latency and optical insertion loss properties of the device.

Each property is represented as a N□N matrix where the row corresponds to the port through which the optical signal ingresses from (input) and the column represents the port from which the optical signal egresses from (output). Each entry in a matrix corresponds to the value used for the particular input/output combination. The latency for a particular input-output port combination is measured as the time between when optical signal enters the input port and when the same optical signal exits the output port. Some of the silicon photonic devices included are: waveguides, couplers, ring resonators, detectors, crossings, filters, modulators, detectors.

<u>Electronic Router Model Parameters:</u>
Clock Rate
Buffer Size
Channel Width
Number of Virtual Channels

<u>Insertion Loss Parameters:</u>
Propagation Loss (Silicon/Other Material)
Waveguide Crossing
Waveguide Bend

Drop Into a Ring
Pass By a Ring

Many of the commonly used parameters are saved in optical_aggresive_parameters.ini and optical_realistic_paramters.ini under PhoenixSim/PhoenixSim/paramters.

Common Abbreviations:
BER bit error rate
BERT bit-error-rate tester
CAD computer-aided design
CMOS complimentary metal-oxide semiconductor
CMP chip multi-processor
CPU central processing unit
CW continuous wave
DCA digital communication analyzer
DDR3 third generation double data-rate
DIMM dual in-line memory module
DRAM dynamic random-access memory
DTG data timing generator
DWDM dense wavelength-division multiplexer
EDFA erbium-doped fiber amplifier
FDTD finite-difference time-domain
FLOP floating-point operation
FSR free spectral range
HPC high-performance computing
I/O input-output
IC integrated circuit
ITRS International Technology Roadmap for Semiconductors
LA limiting amplifier
MOD modulator
MPI message-passing interface
MZI Mach-Zehnder interferometry
NoC network-on-chip
OSA optical spectrum analyzer
OSNR optical signal-to-noise ratio
PhoenixSim Photonic and Electronic Network Integration and Execution Simulator
PPG pulse pattern generator
PSE photonic switching element
RIN relative intensity noise
SMF single-mode fiber
SNR signal-to-noise ratio
SOI silicon-on-insulator
TDM time-division multiplexing
VOA variable optical attenuator

WDM wavelength-division multiplexing
WSSR wavelength-selective spatial routing